

Space Weather Technical Forecast

Issued on Monday, 02 October 2023 at 13:16 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Chance of M-flares throughout. Slight chance of isolated G1/Minor Storm interval, mainly day 3 (04 Oct).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity in the last 24 hours has been Low, with the peak flare a C5.0 at 01/0951 UTC. There are ten sunspot regions on the disc. Growth of AR3451 has now largely stalled, while AR3452 has seen some further slow flux emergence, but also spreading and consolidation of its spots. AR3450 in the southeast has also seen any significant growth in intermediate spots stall, but maintains some slight complexity. After recent emergence AR3453 appears to be stabilising as a small and relatively simple spot. A couple of other small spots remain unnumbered. The other regions are smaller, simpler and either stable or declining.

No Earth-directed CMEs observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by ACE at L1, were indicative of slow wind conditions. Speeds were background, at around 380-350 km/s. Density generally below average. The interplanetary magnetic field (IMF), Bt, was weak, below 7nT throughout. The north-south component, Bz, has been variable in direction, varying weakly between +5nT and -5nT. Phi angle was positive (away from the Sun). Resultant geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at background levels. GOES16 high energy (greater than 2MeV) electrons were Background to Moderate, peaking 454 pfu. Associated 24-hour fluence was below Active (1e8 integrated pfu) threshold and declining. The observation at 02/0000 UTC was 1.21e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate with a chance of further isolated M-class flares. The main M-flare risk is currently from AR3450 and AR3451/52.

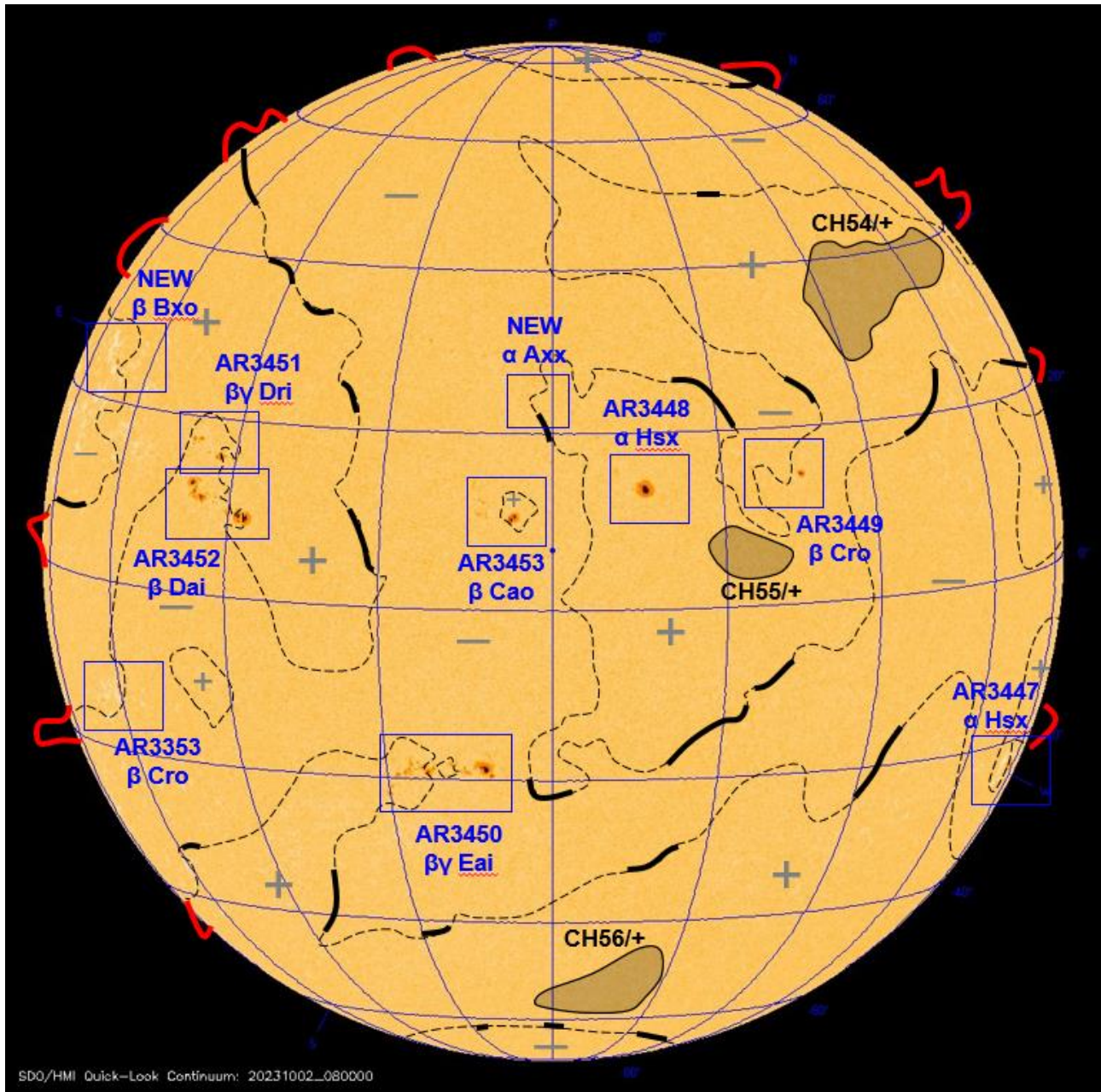
Solar Wind / Geomagnetic Activity: There are currently no Earth-directed CMEs expected. Solar winds current near background, some enhancement possible later day 1 (02 Oct) due to the potential influence of CH54/+, however this is low confidence due to the mid-high latitude location of the coronal hole. Some influence from the fast wind associated with CH55/+ is more likely into day 2 (03 Oct) or day 3 (04 Oct). While more likely to connect due to its location, this is a smaller and newer feature, with low confidence for the strength of any connection. MOSWOC Enlil suggest solar winds of around 450kms are possible. Mainly Quiet geomagnetic activity expected with isolated Unsettled spells. Any fast wind arrival has the potential to bring a spell of Unsettled to Active, with a slight chance of G1 Minor Storm intervals.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

expected to remain at Background levels, with no Solar Radiation storms expected. High energy electron flux (greater than 2MeV) observed by GOES16 is expected to vary between Background and Moderate levels, with the potential of more significant drop-outs of electron flux to occur given the onset of any fast winds. A slight recovery to Moderate, perhaps diurnally high levels is then possible by day 4 (05 Oct). Fluence is forecast to be below Active (above $1e8$ integrated pfu) levels throughout.

Figure 1. Solar Analysis Valid 02/0800 UTC.



Key: Filament ---, Prominence ---, Magnetic Field Line ---, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

No Earth-directed CMEs currently forecast.

Solar winds are currently around background levels, with Earth likely south of any notable fast wind influence from CH54/+. This is located at mid-high latitudes across the north-western disc, although a south-eastern extended lobe may allow for some fast wind influence later on day 1 (01 Oct). However, this remains low confidence due to its northern latitude. Considering its positive polarity, then any connection that does occur is more favoured to be geoeffective this time of year.

Late on day 2 (03 Oct) or more likely on day 3 (04 Oct) further influence from equatorial CH55/+ is possible, as indicated in MOSWOC Enlil. This is a small, non-recurrent feature with low confidence for expected speeds, but may increase solar winds to around 450km/s, waning into day 4 (05 Oct).

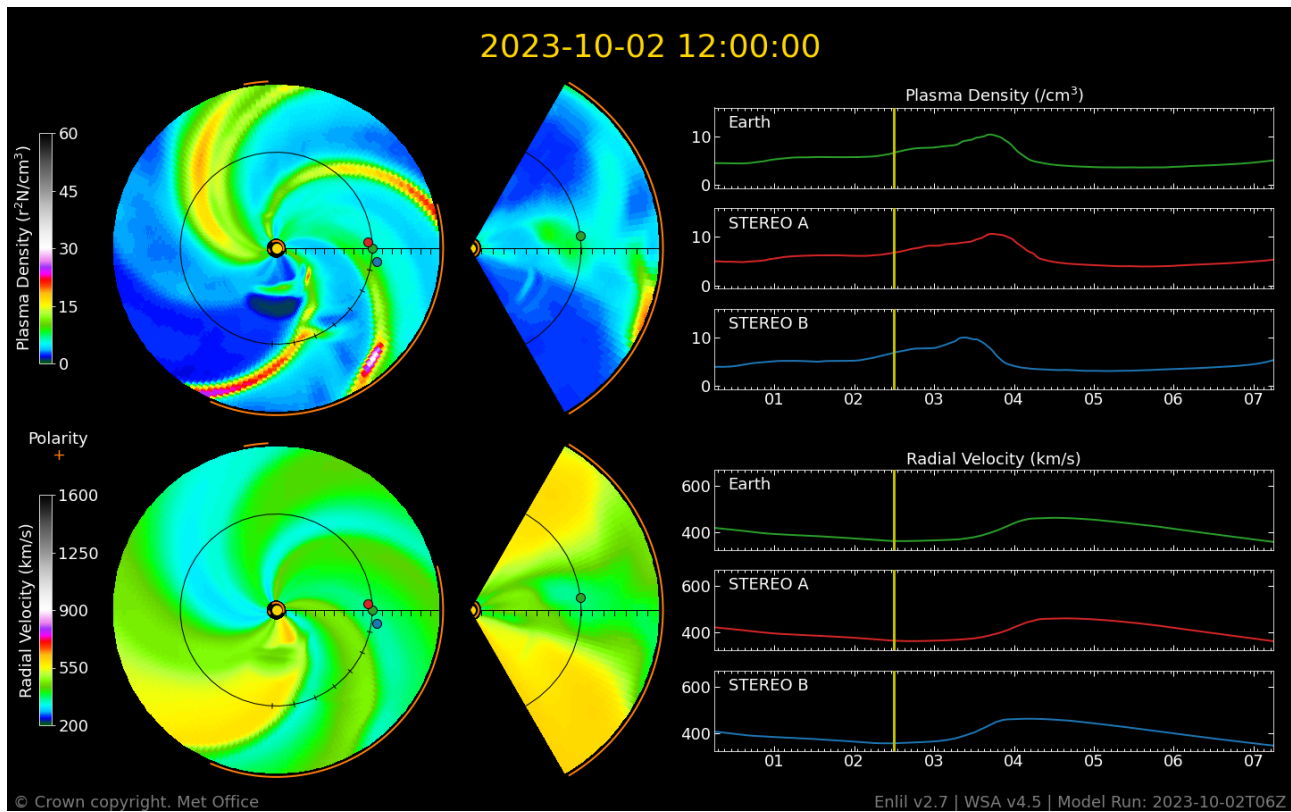
Mainly Quiet geomagnetic activity is expected for much of the period, with isolated Unsettled spells. However, any fast wind arrival has the potential to bring a spell of Unsettled to Active, with a slight chance of G1 Minor Storm intervals.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	10	10	20	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity – Earthbound Coronal Mass Ejections

Nil

Figure 2: Latest MOSWOC ENLIL output showing enhancement into the 3rd Oct, likley associated with CH55/+





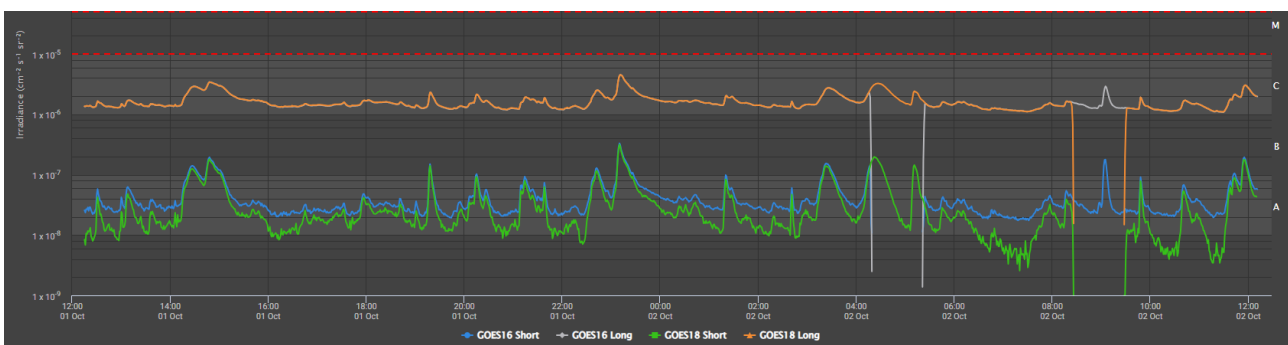
Radio Blackouts - X-Ray Flares:

The solar disk remains generally busy with ten sunspot regions currently, though the majority are simpler and either largely stable or declining. The northeast disc has been the most active area over the recent days, with both AR3451 and AR3452 presenting the bulk of the current flare risk, the latter of these seeing previous M-flare activity. However, growth of AR3451 has now largely stalled, while AR3452 has seen some further flux emergence, but also spreading and consolidation of its spots perhaps suggesting some maturing of both of these features. AR3450 in the southeast remains the other main area of interest, it has also seen growth in intermediate spots generally stall with slight fading of the trailer portion. This region has produced a previous M-flare however, on the 28 Sep, and further flaring remains possible.

Low to Moderate activity is forecast to continue, with a chance of further isolated M-flares, though risk somewhat reduced given trend towards simplification in many of the larger spots. No major regions currently expected to arrive or depart the visible disk during the period with the current risk maintained pending further developments.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: Latest 24hr GOES16/18 X-ray trace.



Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux observed by GOES16 is expected to persist at background levels, with the current sunspots on the disc not expected to produce proton events.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	2	2
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm ⁻² sr ⁻¹ s ⁻¹)						

High Energy Electrons Event ($\geq 2\text{MeV}$):

High energy electron flux (greater than 2MeV) observed by GOES16, is at Background to Moderate levels, having now declined after previous enhancement. This is likely to drop out to become solidly background if any connection to CH54 occurs day 1 (02 Oct), or perhaps more likely due to any connection to CH55 either late day 2 or day 3 (03-04 Oct). A recovery in flux is then possible later day 3 or day 4 (04-05 Oct) to mainly Moderate with a chance of peaking at High during diurnal maximum.

The associated 24 fluence is expected to remain below the Active threshold, with a generally declining trend. This is in agreement with REFM although the model is currently overestimating the current fluence. As any coronal hole enhancement eases day 3 onward, there is a chance of fluence increasing again, but is currently expected to remain below Active.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	1	1	1	5
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 4: Latest MOSWOC NEFM model output

